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Quark-Gluon Plasma in QCD, at RHIC, and in String Theory
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The realization that the high temperature phase of QCD is quark-gluon plasma, with properties qualitatively distinct from those of
the hadronic phase whose quasi-particles make up the quotidian world, goes back more than 30 years. Over that time, we have gained
reliable insight into the thermodynamics of quark-gluon plasma at accessible temperatures from lattice QCD calculations, and we have
understood much about its dynamics in the high temperature limit where it becomes weakly coupled. However, in the last five years
experimental discoveries at the Relativistic Heavy Ion Collider have taught us that, at least at temperatures within a factor of two of
that at which hadrons ionize, the dynamics of quark-gluon plasma is closer to the ideal liquid limit than to the ideal gas limit. These
experimental data demand a theoretical understanding of the dynamics of strongly coupled quark-gluon plasma. Such calculations in
QCD itself are in their infancy, but string theory provides us with robust tools for exactly this purpose, applicable to the quark-gluon
plasmas of many QCD-like theories. I will describe some of the many new results obtained recently from these AdS/CFT calculations,
qualitative insights already in hand, prospects for quantitative insights for those properties that turn out to be universal across many
different strongly interacting quark-gluon plasmas, and the interplay with near-future data expected from RHIC and from the LHC heavy
ion program.